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ENGINEER'S REPORT

ON THE

SURVEY FROM NEW HAVEN CITY

UP THE

CANAL TO PLAINVILLE,

AND THENCE TO

COLLINSVILLE, IN THE FARMINGTON VALLEY.

NEW HAVEN:
HITCHCOCK & STAFFORD, PRINTERS.
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REPORT.

To the Directors of the New Haven and Northampton Company:

To supply a connection of the distant interior with the seaboard which should encourage and excite its manufacturing and agricultural industry, open a market for its products and commodities, promote the occupation of its water power, and confer value upon its woods, its mines and its cleared tracts, was a main object of that work of internal improvement of which yourselves and your company are the proprietors. Since the completion of that work, however, another species of improvement has become so greatly and deservedly the favorite, as to be entitled to the precedence in almost every combination of circumstances which will call for the opening of new channels of intercommunication. It is only where, as in a mining region, an abounding freight peculiarly occasions the demand for improved means of transportation and transit, that the *canal* can enter into competition with the *railroad.*

As might be expected, therefore, there have been already laid, along some of the improved canal routes of this country, parallel railroad lines coëxtensive with, or extending beyond them. These have become lucrative, even in localities where the canal, considered merely in the light of private property, had been proved almost valueless. An illustration of the actual occurrence of such a contrast, may be cited in the Middlesex Canal,—an enterprise by which Massachusetts, as she is wont to do in every worthy enterprise, led the way in the work of internal improvement in the United States. The Middlesex Canal is well known to have been an unprofitable investment, having never yielded to its stockholders, I believe, a dividend of more than two per cent. upon its cost, counting principal and interest; yet the railroad now occupying its locality, and that along the river which constituted, with the canal, one and the same *business channel*, yielded in 1844 a net profit of $144,000, on a capital of $1,900,000. In alluding to the unprofitableness of the Middlesex Canal, I am careful to limit that view to its result as a private investment of capital; for it is not to be denied that its benefits conferred on the business of Boston, and felt in the extension of valuable facilities to the region it traversed, may have far transcended, in a public view, all the outlay of its construction.

The vigorous efforts made to secure a railroad from Worcester, in Massachusetts, to Providence, along the locality of the Blackstone Canal, is another illustration of the view taken above,—so far as they manifest an extensive conviction that the meagre success of the latter species of improvement constitutes no essential bar to the expectation of a good success of the former. In fact, so diverse are the two in their power of accumulating and creating travel, enterprise and production, that every application of conclusions from an experience relative to the one, to the prospective results of the other, involves an essential fallacy.

The canal of which your company are the proprietors, depends for its income upon the ordinary freight and requisitions of a busy agricultural and manufacturing region, whose resources are as yet partially improved, and upon the intercommunication between the populous city at one extremity and the several towns and settlements,—many of them thriving and rapidly increasing,—within its reach and influence. Under favorable circumstances, therefore, it would seem not amiss to have counted upon it, with moderation, (although not sustaining such relations as a railroad would to our grand emporium, New York,) as a source of profit. But its outset was with insufficient means, and its consequent embarrassments, enhanced by interruptions from destructive floods and other unexpected casualties, tantalized expectation and impaired that essential element of prosperity to every work of improvement—public confidence.

Nevertheless, to the community at large, the canal has been productive. It has had a share of influence in the supply, the security and the increase of New Haven, and an early and yet larger influence in the vigorous growth of Westfield, besides an analogous effect at many other points of settlement.

The flourishing villages of Plainville and Unionville owe to it their existence. In addition to the nine mills and manufacturing establishments erected upon its banks, others in the towns of Southington, Bristol and Plymouth, together with the manufacturing operations of Waterbury, Canton and some of the Massachusetts towns, have experienced its favoring influence. Through Connecticut the timbered lands of its vicinity have materially improved in price. It is not necessary to enlarge upon this topic. A construction which for the last fifteen years has borne, on an average, an annual freight of twenty thousand tons, (large masses of which could not have sustained the tax upon their merchantable value of transportation upon common roads,) has, doubtless, yielded *to the body politic* no inconsiderable returns for the original outlay and for the persevering exertions and sacrifices of many citizens,—out of whose number the thoughts of every one of you will instinctively revert to that individual of venerated memory, in whom, preëminently, every proposition for the general good found an advocate, and who in his statesmanship, in his efficacious support of the most excellent and fundamental state institutions, in his fostering care of the general educational means and his beneficial anxiety to improve and adorn the city of his residence, was, in his life time, a pillar of the community whose interest it was his enjoyment to subserve.

Having just executed, in your service, first, an exploration from New Haven to the Southwick Ponds at the north line of the State, and next, an actual survey to the Bristol Basin at

Plainville, and thence, diverging from the canal, to Collinsville in the Farmington Valley, I am prepared with definite statements respecting the feasibility of the work you have in contemplation. The proposition is to lay a single way or track upon the towing path or the berm bank of the canal, according as the one or the other shall be most favorable,—widening or shifting the banks where necessary, or departing from them entirely where a much greater directness would be thereby obtained. By the table of alignment which I shall give, you will perceive that such a location will embrace, between the Basin wharf in New Haven and the Bristol Basin in Plainville, about eight miles and one fourth of curved, and about nineteen miles and one half of straight line; and from Bristol Basin to Collinsville, about three and a half miles of curved, and eight of straight line. By the table of gradients you will perceive that no inclination exceeds forty feet in a mile, and that only four miles and two thirds exceed thirty feet. As might be expected in an instance where economy of construction is greatly to be promoted by following—although not implicitly—the alignment of a canal, the curvatures will be, in certain parts, somewhat more abrupt than would be desirable; yet the inclinations and curvatures, taken as one combination, will notwithstanding compare advantageously with the same upon superior works of this description.

In economy of construction, the following distinct points of advantage present themselves: First, for nearly the entire twenty-seven miles to Bristol Basin, the earthwork and masonry of the roadway are principally executed,—the chief exception being at the valley of the Ten Mile river: Second, the right of way is already, for the most part, held by yourselves in possession: Third, the material is, throughout, of the easiest kind for excavation; and no replacement of unsuitable materials by better, for the formation of the road bed, can be requisite: Fourth, the railroad will require fencing only on one side, and for this the present canal fences will generally suffice by removal.

A due consideration of these distinct and special advantages, may explain and justify to your minds the inconsiderableness of the average expense, on this part, of preparing the roadway,—shown, by my estimate, to be about twenty-three hundred dollars per mile, or not more than one fourth the sum usually requisite for such construction. Here I may suggest that, in addition to the advantage of materials for the roadway the best fitted to resist the action of frost of all that are known, you will have the canal, on one side, forming a receptacle for the snows of winter, while the depression of the natural surface below the canal banks often supplies the same on the other. Nor are these valuable qualities detracted from, so far as I am aware, by any of an opposite description.

From Bristol Basin to Collinsville, the location will partake of the qualities already ascribed to the southern division of the survey, in all the particulars of alignment, gradients and (with the exception of a few rocky localities) the easy character of the excavations. But as we now miss the favor of a canal bank for our roadway, and of ready made constructions for passing the streams, the average of this division, although moderate, is a multiple by three of the southern average. The three passages of the Farmington river provided for by viaducts in the estimate, may be reduced to a single passage at Collinsville, and probably with an advantage on the whole.

Inasmuch as a double extension beyond Plainville may be contemplated,—one up the Farmington Valley in the direction of the present survey, and one up the canal towards Westfield, the exploration was continued northward as far as to the Southwick Ponds. The passage of the Farmington river at the present aqueduct will involve no burdensome expense,—the new requisite construction being supported upon an extension of the existing piers. For several miles the canal bank is more elevated than the banks below Plainville, and would prove, I imagine, less strikingly commodious, yet offering, substantially, the like facilities.

But, since the banks are to be occupied by the railway, will not the engines and their trains, it may be asked, interfere injuriously with the towing path for the use of canal boats,—especially in the parts through which that travelled path will be entirely occupied? My views on this important question I have not failed to compare with those of the Superintendent of your canal, and I find that the interruptions will be but momentary and without danger or serious hindrance to the boatmen, who, knowing the established passages of the trains, will time their progress to avoid an encounter on those sections where interference could take place. Except in presence of the trains, the draft horses can traverse the space between the rails, on a path accommodated to that use.

This apprehension of interference (slight as it is seen to be in the light of the foregoing considerations) is entirely done away by a circumstance to which no allusion has hitherto been made. One feature of your own project would be, that the tonnage of the canal may be, chiefly, transferred to mingle with the mass of freight upon the railroad,—thus placing at your command most of the lockage, to be thenceforth expended in union with your present surplus water, for the purposes of water power at favorable sites, upon your banks, for mills and manufactories. The rare conjunction of water privilege with railway facilities in juxtaposition, must secure, it would seem, on the completion of your design, to every one of these sites, an immediate occupation. I have not enjoyed an opportunity to gauge the sources of your supply, or to determine by personal observation the volume of surplus water. Your agent, however, has done both; and the facts and measures he has furnished are the basis of my calculation. Between New Haven and Bristol Basin, there are eighteen sites of from eight to seventeen feet head and fall, and with a flow *through the ordinary dry seasons,* varying in different parts from twenty-six hundred to forty-five hundred cubic feet a minute for twelve hours of the day, and supplying, through the same twelve hours, powers of from thirty-five to eighty horse power, according to the usual mechanical estimate of thirty-three thousand cubic feet raised one foot high in a minute to each horse power,—but, according to the customary estimate at Lowell, not more I believe than two thirds the rates above specified. Therefore, if the estimate be made for work through the entire day, these powers must be rated (adopting the Lowell standard) at from about twelve to twenty-seven horse power. Above Plainville the entire Farmington river may be taken in the dry season forty feet above its level beneath the aqueduct, and used for a head and fall of twenty-five feet. The Southwick Ponds are a reservoir of eight hundred acres that may be drawn down seven feet and yield a surplus above waste and evaporation of eleven hundred feet a minute for twelve hours, and with a fall of sixty feet in half a mile. At the low level at Westfield, the entire lockage from both the south and the north summit levels may be employed,—being two thousand feet for twelve hours upon eight feet head and fall. Finally, the surplus from the great Westfield feeder, of three thousand feet per minute for twelve hours, can be employed upon seventy-two feet of descent. I find, upon the data furnished me, the aggregate power at command to be, *for twelve hours each day, sixteen hundred and fifty horse power,* according to the common mechanical estimate, or about *eleven hundred,* according to the Lowell measure of power. At the most moderate estimation for the value of a horse power, it will be manifest that the income from leases will exceed, two or three times, the present tolls or their prospective amount for a long period to come.

Our next inquiry relates to the prospective profitableness of the contemplated railroad. To procure the most certain data upon this important question, care has been taken that in the towns not immediately adjoining the canal, but whose business, with that of the canal towns, would form a source of income, statistics should be collected on the authority of citizens able to supply facts and judicious estimates. The subject of investigation has been the *present tonnage and travel* for which the proposed railroad, if extended to Collinsville, would be the natural channel. I have sought mainly to ascertain, from these statistics, the present business which waits—as one may say—the execution of your project.

The natural basin of your railroad is that north and south zone of Connecticut which lies between the range of East Rock, Mount Carmel, the Blue Hills, and the Farmington and Talcott Mountains, on the east, and the Naugatuck river on the west; the region adjoining this on one side being drained by the railroad from New Haven to Springfield, and that on the other, in like manner, by the Housatonic railroad. It is narrow to the south, for many miles above its exit, but expands northward, and covers, in a measure, the head streams of the Naugatuck, spreading into Massachusetts, and inviting a junction with the Western Railroad at Pittsfield, in one direction, or at Westfield in another. Between this region, however, and the extent which is drained—so to express it—by the Housatonic Railroad, lies the Naugatuck basin itself, a valley numerously provided with thriving villages and manufactories, and possessing an element of yet more abundant thrift and settlement, in the yet unoccupied power of the streams, especially of that main stream which gives name to the valley; and the execution, whether remote or near, of the contemplated project from Waterbury to New Haven, will supply an independent accommodation to several important towns on the western border of your basin, whose business would otherwise flow in your channel. It is obvious and not uninteresting, at this point, to remark how these and other naturally defined regions of Connecticut have their outlet and issue into the grand contemplated channel of improvement between New Haven and New York, the opening of which is thus favored by the arrangements of nature, as well as insured by the laws of civil intercourse.

For reasons which the above general view readily suggests, I have left out, in my estimate of your resources, the towns of Waterbury, Watertown, Plymouth, and the vicinity, as belonging to the Naugatuck channel. After this curtailment, there remain, in the broad region which will feel an indissoluble connection with your enterprise, when once advanced to Collinsville, eighteen towns and villages, containing a population of more than forty thousand,—the principal of which are Southington, Plainville, Avon, Unionville, Collinsville, Canton, Barkhamstead, Hartland, Colebrook, Winsted, New Hartford, and Bristol. From the facts derived in the eighteen towns alluded to, and based on authentic information, I gather the amount of income that I now proceed to estimate.

In the first place, the canal freight between Avon and New Haven is specifically ascertained to be, at this period, eighteen thousand tons per annum. The full occupation of the eighteen factory and mill sites, before mentioned, on the canal, will insure, together with that at the Farmington level, a large accession—not less, I presume, than four thousand and five hundred tons. I find, in addition, an aggregate of eight thousand and six hundred tons, from the towns in what I have described as your natural basin. Although a great increase may be anticipated when business in these towns shall have become stimulated—yet more, and very greatly more, by the railroad than the same has been by the canal—I have made no account of any augmentation of tonnage, except that specified as certain to accrue from the occupation of your own water privileges.

The amount of existing travel which would enter the proposed channel of conveyance is found to be, already, forty each way, or, together, eighty per day. But the efficacy of a railroad to accumulate on itself the ordinary travel of private, as well as public conveyances, and to multiply the frequency of transit, for purposes of enjoyment and of business, is so well established, that it seems to be no *assumption*, but rather an ascertained truth, that the existing travel, whatever be its amount, will be doubled or trebled by a railroad. I therefore add to the amount above stated, one hundred and twenty-five per cent., as a very credible increase within a moderate period. These things being premised, I state the probable gross income, at reasonable rates of fare and transportation, as follows:

Existing tonnage,	26,600 tons.	
Increase from factories,	4,500 "	
Total tonnage,	31,100 tons, at $1.50=	$46,650.00
Existing travel, 80 per day, for 300 days,	24,000 passengers.	
Prospective increase,	30,000 "	
Total travel,	54,000 passengers, at $0.75=	40,500.00
Mails, - - - - - - - -		1,800.00
Gross annual income,		$88,950.00
The expenses of *freight roads* generally exceed half the receipts; those of *passenger roads* are, very closely, one third of the receipts; I therefore call the probable expense for the above business, - - - - - - -		$43,000.00
Leaving for net annual profits,		$45,950.00

I would not present the foregoing estimate of profits as certain to be realized in the very first year of your improvement. A reasonable time must be allowed for the latter to exert its power upon the business and travel of the region. Even under this limitation I should hesitate—my authorities notwithstanding—to present it confidently, but for the frequency with which this kind of improvement outruns, in its proceeds, our original anticipations. The Housatonic Railroad might be instanced to enforce this idea. Without any superiority, when compared with your contemplated work, either in the city where it takes its origin, or in the richness or activity of the regions traversed,—but under a positive and prodigious disadvantage, known to every one, to which yours will not be subject, (and from which, happily, that is, itself, speedily to be delivered,) its gross receipts in 1844, upon seventy-four miles (yours being forty) were $151,500. Facts, in my understanding of them, would not warrant the supposition that the Housatonic Railroad has enjoyed, by its connection with the Western Railroad, a main source of its income; but even that source yours can scarcely fail, if once prosperously begun, likewise to enjoy, by a similar union at Pittsfield. To a portion of your body it is known that the Farmington valley was, formerly, surveyed, and a practicable route to West Stockbridge ascertained. Through that route your railroad, if it once *looks* into and obtains a foothold in the Farmington valley, cannot fail to be urged, in virtue of that quality of self-propagation which obtains in every instrument and means which is characterized by an adaptation to subserve, through a considerable territory, the essential prosperity of a commonwealth,—not to say, as in this instance, of two.

It will be seen, in the sequel, that the capital requisite to complete and put in opeartion a road to Collinsville will be Six Hundred Thousand dollars. The amount of net profits is a larger per centage upon this capital than can be realized in ordinary and not hazardous investments. The main facts of my estimate are, in the opinion of men whose judgment is the most worthy, quite within bounds; but if any one shall esteem their judgment, in this case, too sanguine, there is room for large abatement, without impugning the general issue—the sound and profitable character of the work.

Having thus disposed of the most essential preliminaries, it remains to ascertain and exhibit the COST of CONSTRUCTION.

For this I have, in addition to my own explorations, the surveys of two able and experienced assistants, namely, Mr. Elizur Goodrich, upon the upper division, from Collinsville to Bristol Basin, and Mr. Michael Ritner, upon the greater part of the lower division, from Bristol Basin to the vicinity of New Haven,—a small part of the field work, however, on this division, having been executed by Mr. Goodrich. The computations of earthwork have been furnished by the same. A single track has been contemplated, with twelve feet breadth of surface, for the banks, and twenty for the excavations; but, to give room for settling and abrasion, fourteen feet upon the banks has been the dimension adopted in the estimate.

For the general features of the route reference is made to the tables of alignment and gradients given below. Full justice to the former requires the observation, that improvements may be made in the final location; and, in the opinion of Mr. Ritner, who laid the line from Bristol Basin, southward, all curves, on that division, may be so moderated as not to exceed five degrees to a hundred feet, in any instance. Between Bristol Basin and Collinsville a short distance of abrupt curvature would, probably, be retained.

TABLE I.

Being a summary of the Alignment for the First Division, or from New Haven Harbor to Bristol Basin,—of the Second Division, from Bristol Basin to Collinsville,—also of the Entire Route in one view.

Degree of Curvature.	Radii in Feet.	DIVIS. I.		DIVIS. II.		WHOLE ROUTE.	
		Length in Miles.	Deflection	Length in Miles.	Deflection	Length in Miles.	Deflection
½°	11460			0.019	½°	0.019	½°
1°	5730	0.435	23°			0.435	23°
1½°	3820	0.076	6°	0.284	22¼°	0.360	28¼°
2°	2865	1.169	123½°	0.133	14°	1.302	137½°
2½°	2292	0.095	12½°	0.320	42°	0.415	54½°
3°	1910	1.058	167½°	0.493	78°	1.551	245½°
4°	1432	2.236	472¼°	0.594	125½°	2.830	597¾°
5°	1146	0.818	216°	0.523	138°	1.341	354°
6°	955	1.914	606¼°	0.403	127½°	2.317	733¾°
7°	820	0.116	43°	0.393	145°	0.509	188°
8°	716	0.173	72°	0.231	97½°	0.404	169½°
9°	636			0.096	126½°	0.096	126½°
10°	573	0.114	60°	0.103	54¾°	0.217	114¾°
Totals,		8.204	1802°	3.592	971½°	11.796	2773½°
Straight Line,		19.501 miles.		7.961 miles.		27.462 miles.	
Whole Distances,		27.705 "		11.553 "		39.258 "	

TABLE II.

Being a Summary of the Gradients for each Division separately, and for the Entire Route.

Gradients.	Division I.			Division II.			Entire Route.		
	Dist. in Miles.	Ascent north.	Descent north.	Dist. in Miles.	Ascent north.	Descent north.	Dist. in Miles.	Ascent north.	Descent north.
Level.	13.547			0.098			13.645		
0 to 5	1.705	1.00	1.00	1.553	1.00	3.00	3.258	2.00	4.00
5 " 10	1.425	14.00		1.590		13.00	3.015	14.00	13.00
10 " 15	0.380	5.00		2.310	28.00		2.690	33.00	
15 " 20	2.705	35.00	15.00				2.705	35.00	15.00
20 " 25	3.485	66.70	8.20	0.757	18.00		4.242	84.70	8.20
25 " 30	2.347	63.00		2.651	53.00	19.00	4.998	116.00	19.00
30 " 35	0.474	15.00		2.594	55.00	29.00	3.068	70.00	29.00
35 " 40	1.637	32.00	32.00				1.637	32.00	32.00
Total,	27.705	231.70	56.20	11.553	155.00	64.00	39.258	386.70	120.20
Total Ascent & Descent,	287.90					219.00			506.90

I present the estimate of cost in two principal Divisions, (as above,) each subdivided into Sections.

DIVISION I.

Extending from New Haven Harbor to Bristol Basin.

SECTION FIRST.

This reaches from the Canal Wharf in the Harbor to Picket No. 240 above Lock No. 18, not far from the sixth mile stone, on the turnpike, north of Centreville. The Canal Basin will be crossed on piles. The towing path may be occupied with a trestle work to Cherry street; thence to Court street the road may most conveniently occupy, in part, Union street and its continuation. Again, for the whole extent to the lock adjoining State street, the towing path must be occupied by a trestle work, and beyond that lock by the ordinary track to leave the city. All streets may be passed on a level, or nearly so. From "Love's," where Picket No. 0 is driven, the survey was conducted along the spoil bank on the west side. Near the Meeting House, for half a mile, the eastern margin of the road was preferred. On leaving the sandstone point south of the high canal embankment opposite Centreville, the road will recross to the eastern or towing path side, unless that should take place a considerable fraction of a mile yet more south, to strike, in a direct line, across the hollow at Centreville to Lock No. 18. For nearly the entire extent of this section, the two sides offer about equal advantage.

The cost will be, for nearly seven miles and a half—

Earth, - - - -	$6,660.72
Sandrock, - - - -	450.00
Piling across Basin, - - -	4,880.00
Trestle work, - - -	2,493.75
Construction, &c. in city, - -	2,500.00
Bank walls, - - - -	700.00
Parapets raised of two culverts, -	185.00
Ten swing bridges for canal, -	1,500.00
Two viaducts over do. - -	2,000.00
Ten cattle guards at roads, - -	250.00
Six farm crossings, - - -	120.00
Grubbing, - - - -	15.00
Contingencies, - - -	1,100.00
Total, grading section first, -	$22,854.47

SECTION SECOND.

In the six and a quarter miles of this Section, the line passes the toll gate in Hamden, and at the narrow pass of "the Steps" Mount Carmel also; and terminates about one fourth of a mile above Lock No. 12. It is laid upon, or closely adjoining the towing path,—except in a few instances of necessary deviation, of from a few rods to half a mile, to avoid a lock or escape short curves. Immediately below Lock No. 12, however, the canal is crossed and the railroad laid in the low meadow on the west.

The cost of the Section will be—

Earth, - - - -	$4,703.73
Bank walls, - - -	200.00
Masonry, - - - -	448.50
Ten swing bridges, - -	1,500.00
Viaduct over canal, - -	1,000.00
Five road crossings, - -	125.00
Cattle guards, - - -	150.00
Contingencies, - - -	800.00
Total, grading section second,	$8,927.23

SECTION THIRD.

Through this section,—an extent of a little more than four miles and one third,—the line occupies, alternately, the towing path, the spoil banks, and the flat lands contiguous to the canal. At the Cheshire road, below lock No. 11, the towing path is abandoned for the flat, but resumed at the curve below Beachport. The section terminates three hundred feet west of the canal, opposite the house of Mr. John Russell.

The work is as follows:

Earth, - - - -	$2,240.00
Culvert, - - - -	275.00
Three swing bridges, - -	450.00
Road crossings, - - -	150.00
Cattle guards, - - -	75.00
Grubbing, . - - -	50.00
Contingencies, - - -	350.00
Total, grading section third, -	$3,590.00

SECTION FOURTH.

Encountering, at first, a deep cut, the line passes on the east side of the road, opposite Clement Beecher's. Ten Mile river will be crossed four hundred feet east of the road. The valley will require a heavy embankment, and the canal will be again met at Hitchcock's Basin. Nearly one mile and a quarter beyond, the line diverging from the canal leaves lock No. 8 one hundred feet to the east, and, passing through the birch woods for one quarter of a mile, meets the canal again at Eight Mile river and crosses that river at its mouth. Near Grannis' Basin the section terminates, having a length a little short of six miles.

I estimate the cost as follows:

Earth, - - - -	$14,741.44
Piling at Eight Mile river, -	420.00
Road bridge, - - -	525.50
Culvert for Ten Mile river, -	975.70
Viaduct over canal, - -	1,000.00
Five swing bridges, - -	750.00
Road crossings, - - -	225.00
Cattle guards, - - -	100.00
Grubbing, - - - -	50.00
Contingencies, - - -	2,000.00
Total, grading section fourth, -	$20,787.64

SECTION FIFTH.

The estimate of this section, which extends over three miles and three quarters, to Bristol Basin, is as follows:

Earth, - - - -	$7,429.50
Viaduct over canal, - -	1,000.00
Two swing bridges, - -	300.00
Three small culverts, - -	150.50
Farm and road crossings, - -	225.00
Cattle guards, - - -	75.00
Contingencies, - - -	850.00
Total, grading section fifth, -	$10,030.00

SECTION SIXTH.

From the basin in Plainville the line finally diverges from the canal and crosses the valley of the Pequabuck. The embankment of the valley is succeeded, for about a half mile, by a cut of nine feet. Lewis Brook, although a small stream, having a valley depressed thirty feet below the grade, compels an embankment of 50,000 cub. yards, for which, however, the material is at hand. The remainder of the section occupies a plain, somewhat broken by ravines. About one third of a mile north of the Litchfield turnpike the section terminates.

The estimate for the entire six miles and a quarter stands thus:

Earth, - - - - -	$12,176.71
Pequabuck viaduct, - -	1,100.00
Two arched culverts, - -	1,250.00
Arched roadway, - - -	2,580.00
Two box culverts and paving, -	384.00
Fifteen farm and road crossings, -	250.00
Piling at Pequabuck, - -	4,000.00
Ditching and grubbing, - -	324.72
Four cattle guards, - -	100.00
Contingencies, - - -	2,650.00
Total, grading of section sixth,	$24,815.43

SECTION SEVENTH.

From the plains northward to the Farmington river the line is laid upon the slope which bounds the valley of that river; but the alignment may be improved. Reaching the west bank of the river, near the dwelling of Capt. Porter, and crossing his meadow with a moderate embankment, we strike the sidelying ground west of the Feeder dam and pond, and, alternately, cut the hill points and rest upon the flats. At the entrance of Zack's Brook the river is pushed abruptly to the right by a projecting but narrow crest, which we cut thirty feet in depth. About one fifth of a mile beyond Zack's Brook, and less than a mile south of the bridge that crosses to Union village, the section terminates, in a length, altogether, of three miles and a quarter.

The items of expense stand, in detail, thus:

Earth, - - - -	$9,842.56
Two arched culverts, - -	1,475.50
Nine box culverts and foundations,	972.00
Seven farm and road crossings, -	125.00
Changing road, - - -	60.00
Ditching and grubbing, - -	84.80
Two cattle guards, - -	50.00
Contingencies, - - -	1,300.00
Total, grading section seventh,	$13,909.86

SECTION EIGHTH.

Crossing meadows, for one quarter of a mile, and occupying, for four hundred feet, the present road, our line advances, upon the flats, past the dwelling of Mr. John Stewart, near to which it crosses the Farmington river, with an elevation of nineteen feet. Curving, sharply, for five hundred feet, westward, it encounters, after a straight course of three fourths of a mile, the rocky side hill, which here shuts down, for half a mile, upon the river.

Coming, next, upon a favorable plain we follow, in succession, the river margin and the steep side hill to a second crossing, twenty-five feet above the river, and thence, for a fraction only of a mile, to a third crossing, which lands us at our northwestern terminus, in the village of Collinsville.

The length is four miles, and will cost as follows:

Earth, - - - -	$6,034.87
Rock, - - - -	8,738.00
Three river viaducts, - -	25,610.00
Six box culverts, - -	480.00
Slope wall, - - -	214.50
Road changed, - - -	201.00
Ditching and grubbing, - -	454.14
Eleven road and farm crossings,	240.00
Cattle guards, - - -	100.00
Contingencies, - - -	1,800.00
Total, grading last section, -	$43,872.51

From the foregoing computations the aggregate cost of grading the two divisions will appear, together with that of the entire surveyed route, in the following amounts:

DIVISION I.

Section first,	$22,854.47	
" second,	8,927.23	
" third,	3,590.00	
" fourth,	20,787.64	
" fifth,	10,030.00	
Total, grading from New Haven to Bristol Basin, 27.705 miles, at $2,389.08 per mile,		$66,189.34

DIVISION II.

Section sixth,	$24,815.43	
" seventh,	13,909.86	
" eighth,	43,872.51	
Total, grading from Bristol Basin to Collinsville, 11.553 miles, at $7,149.47 per mile,		$82,597.80
Total, grading 39.258 miles, at $3,789.98,		$148.787.14

I come next to the SUPERSTRUCTURE. An estimate of this is difficult in the fluctuating condition of the market as to iron. I should presume, that, notwithstanding the late extravagant rates, you might ultimately obtain it for $75 a ton, and accordingly I so estimate it; and, as your road will be easy in its gradients, the engines should not be of the heaviest class, or such as will require a rail of more than fifty pounds to the yard. Sleepers of excellent quality can be obtained in the vicinity, and, of course, on good terms. Including a slight extra expense for preparation of a path for the draft horses, in the parts where the towing path will be fully occupied, I find the cost of a single track, or way, to be $7500 per mile.

For the EQUIPMENTS of the road I give the details following:

Four engines, - - -	$30.000
Five 56 passenger cars, - -	9,000
Twenty-five 7 ton freight cars, -	20,000
One main depot, - - -	6,000
Two small " - - -	5,000
Four stopping places, - -	2,000
Two engine and car-houses, -	10,000
Watering stations and wood sheds, -	5,000
Repair shop, - - -	2,000
Two miles turnouts, - -	24,000
Signs for crossings, &c., - -	3,500
Turning tables, &c., - -	2,500
Total equipments, $3031.23 per mile,	$119,000

To Bristol Basin *fencing* will be requisite on one side only, and for that purpose the present canal fence will, by removal, be sufficient through most of the distance. Southward of Bristol Basin $100 will be allowed, and northward $600. This item may be estimated at $10,000. Again, a few buildings will, of necessity, be removed, and land must, in some cases, be purchased,—and these, with other contingencies, may be estimated at $12,000. To these should be added about $12,000 for engineering and superintendence. For all these items $850 per mile may be allowed. A statement of the entire expense may now be made, in the following

SUMMARY,

Exhibiting the cost from New Haven Harbor to Collinsville.

Grading of 39.258 miles at	$3,789.98	per mile,	$148,787.14
Cost of track, -	7,500.00	"	294,435.00
Equipments, -	3,031.23	"	119,000.00
Land, fencing and engineering,	850.00	"	33,369.30
Entire construction, at	$15,171.21	"	$595,591.44
The corresponding estimate to Bristol Basin, at	13,776.91	"	$381,689.00

By the execution of the enterprise, of which a complete estimate has now been presented, an incidental benefit to the canal will arise, which may deserve a passing notice. In certain localities, earth for the railroad can be most conveniently procured by deepening or enlarging the canal. In certain other localities the same result may be secured at a trifling cost; and it is reasonable to expect that, for what purpose soever the canal shall be continued in action, the construction of the railroad will issue in, and be auxiliary to its improved condition.

Before concluding this report, I must revert to a topic which deserves more than the slight notice incidentally bestowed upon it in the progress of my preliminary descriptions. I allude to the admirable entrance into, and passage through New Haven, and the *prompt* connection with its harbor,—at once convenient for the inhabitants and advantageous for commerce,—which the canal has preserved and offers through the very heart of the city. A similar opportunity of accommodation to municipal interests the city of Troy, in the instance of the Troy and Greenbush railroad, elected to improve by bestowing upon that construction a passage for its trains directly through one of the central and populous streets. The speed of the engines and all the conditions of the passage must, of course, in every such instance, be subject to regulation and restriction by the city authority; but the freedom from danger and interference in the closely packed city and street I have adduced as an exemplification, has a far ampler ground and security through the open and nearly unincumbered way that subsists along the section of the canal through New Haven.

Finally, while the conclusions of this document evince the value to yourselves of the proposed undertaking, through its promoting the occupation of your water power, and realizing to your treasury the justly to be expected income, they would seem to assure you of the coöperation of the large section of Connecticut whose interests (as well as, most emphatically, those of New Haven, as a city,) are coincident in this matter with your own. Upon a sagacious people they urge the occupation of privileges which are their proper possession. To men who are bent on promoting "the greatest good of the greatest number," they present the idea of an essential advantage accruing to the inhabitants of one of those grand basins, as I have termed them, into which nature has apportioned Connecticut; by her arrangements of the hills and water courses,—arrangements which have a controlling influence over the channels and boundaries of commercial intercourse. They advance beyond even this, and open a distinct, although perhaps a distant prospect of access to some important towns in western Massachusetts. It is not altogether the fact, that these ideas are now, for the first time, brought to public notice. The great and mutual advantage, in particular, of a close connection of the upper Farmington Valley with the seaport of New Haven, is too obvious a matter entirely to have escaped attention.

I am, gentlemen,
Respectfully, your obedient servant,
ALEXANDER C. TWINING.

September, 1845.

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